DOCUMENT RESUME

ED 170 108 SE 024 951

TITLE	Reviews of Data on Science Resources, No. 31, May 1978. A Comparison of National Industrial R&D Estimates with Actual NSF/Census Data.
INSTITUTION	National Science Foundation, Washington, D.C. Div. of Science Resources Studies.
REPORT NO	NSF-78-303
PUB DATE	May 78
NOTE	11p.; Not available in hard copy due to marginal legibility of original document
AVAILABLE FROM	Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Stock Number 038-000-00368-2; $0.80)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Annual Reports; *Census Figures; Comparative Analysis; Development; *Expenditures; Federal Aid; *Financial Support; Reports; Science Education; Scientific Research; *Surveys
IDENTIFIERS	National Science Foundation

ABSTRACT

The National Science Foundation (NSF) publishes information on R&D expenditures by American industry based on data collected by the Bureau of the Census. Other organizations publish data on the same issue collected by surveys or derived from secondary sources. Differences exist between these two data. In an effort to understand the reasons underlying the differences, the paper compares the data published by these organizations with the NSF/Census data, concerning R&D expenditure in U.S. industry. The paper describes in detail each of the various sources of industrial R&D data and includes tables to show relative differences between their data and NSF/Census data. A description of the NSF/Census survey is also included. (GA)

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Reviews OF DATA ON SCIENCE RESOURCES

NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C. NSF 78-303 No. 31, May 1978

A Comparison of National Industrial R&D Estimates With Actual NSF/Census Data

Introduction

The National Science Foundation (NSF) annually reports information generated by one of its surveys on R&D expenditures by American industry, based on data collected by the Bureau of the Census. Other organizations publish data on industrial R&D expenditures collected by surveys or derived from secondary sources. Five of the seven data sources studied in this paper use the NSF/Census data as a base.

Frequently, inquiries are received which question differences between the NSF data and data published by these other organizations. To understand better the reasons underlying these differences, this paper has been prepared to compare the data published by these organizations with the NSF/Census data, and to describe the methodologies and content of the data published by various sources.

The descriptions contained in this paper have been reviewed by the concerned organizations and their comments have been incorporated. While several of the data sources, including NSF, publish R&D data for other sectors of the economy, this discussion is confined to data concerning only R&D performance in U.S. industry.

Summary

NSF annually publishes *National Patterns of R&D Resources*, which covers R&D spending for each of the four sectors of the economy. Estimates of industrial R&D spending for the ensuing year are derived from analysis of recent trends in industrial and Federal R&D funding, review of Federal R&D budgets in *Special Analysis, Budget of the U.S. Government*, and in informal discussions of company plans with about 50 industrial R&D directors. Estimates have varied from NSF/Census actual data between 0.4 percent to 3.9 percent over the 1972-76 period.

McGraw-Hill queries approximately 1,200 companies on expected R&D funding for the coming year and a percent change estimate for three years into the future. Indications are that, in general, the response from companies is low. Estimates of total R&D spending by industry over the 1972-74 period differed from NSF/Census data by a range of −3.9 percent to +.01 percent. Individual industry estimates have shown greater differences—as much as 62 percent.

Industrial Research[1] provides estimates at the all-industry total level for R&D spending. Estimates are derived from informal discussions with R&D managers and the magazine's opinion poll. The 1971-74 estimates have come between 0.4 percent and 8.9 percent of NSF/Census figures.

Research/Development[1] forecasts R&D funding for the ensuing year for each of the major sectors of the economy but without individual industry

[1]In April 1978 *Industrial Research* and *Research/Development* combined to become *Industrial Research/Development.*

Prepared in the Industry Studies Group, Division of Science Resources Studies.

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SE 024 951

breaks. Forecasts utilize Securities and Exchange Commission reports (form 10-K), company annual reports, and a phone survey of about 45 companies. Over a 3-year period R&D forecasts have differed from NSF/Census data by as little as 1 percent and as much as 9 percent.

Battelle, by using an economic model, projects R&D funds by source and performer, including individual industries, from secondary source data. Again, total R&D estimates run fairly close to NSF figures, within 1 percent or 2 percent; individual industry estimates differ from NSF/Census data by as much as 24 percent.

The *Industrial Research Institute* (IRI) occasionally conducts a survey of its membership, about 250 companies, to obtain information on the relative changes in R&D spending by the companies. Results of the survey are compiled in a manner which generally prevents direct comparison with other sources of data.

The *Securities and Exchange Commission* (SEC) reports (forms 10-K or 10-Q) and information from company annual reports form the basis for estimates by *Inside R&D* and *Business Week*. Publicly held companies, with the exception of companies that spend less than 1 percent of their total revenue on research and development, are required by law to file R&D information with the SEC annually. Also, regulated utilities and transportation companies are generally exempt from filing R&D information. These exceptions result in the exclusion of some companies with relatively large R&D programs, and most of the companies in certain industry categories, such as the food industry. SEC definitions are imprecise, resulting in known cases where company R&D data reported to the SEC contains data for activities that fall outside the scope of research and development as defined by NSF.

Table 1 proves a quick reference to data covered in the various surveys and estimates.

In the remainder of this paper, each of these sources of industrial R&D data are described in detail, including, where appropriate, tables showing relative differences between their data and NSF/Census data. A description of the NSF/Census survey is also included.

TABLE 1.—COMPARISON OF NATIONAL INDUSTRIAL R&D DATA

Major data elements	Data sources							
	NSF/ Census	*National Patterns*	McGraw Hill	*Industrial Research*	*Research/ Development*	Battelle	IRI[1]	SEC (Form 10-K)
Total industry R&D expenditures	YES	YES	YES	[2]YES	[2]YES	YES	YES	(3)
Individual industry R&D expenditures	[4]YES	NO	YES	NO	NO	YES	NO	(3)
Projection beyond current or ensuing year	NO	YES	YES	NO	NO	NO	NO	NO
Source of R&D funds	YES	YES	NO	NO	NO	YES	YES	YES
Net sales	YES	NO	NO	NO	NO	NO	YES	YES
Total company employment	YES	NO	NO	NO	NO	NO	YES	YES
Character of work	[5]YES	YES	NO	NO	NO	NO	NO	NO
Type of cost	YES	NO	NO	NO	NO	NO	YES	NO
Energy R&D	YES	NO	YES	[5]YES	NO	NO	YES	NO
Pollution abatement R&D	YES	NO	YES	NO	NO	NO	YES	NO
R&D contracted out	YES	NO	NO	NO	NO	YES	YES	NO
R&D employment	YES	YES	NO	NO	NO	NO	[5]YES	YES
Product/process R&D	NO	NO	[5]YES	NO	NO	NO	YES	NO
Capital R&D spending	NO	NO	NO	NO	NO	NO	YES	NO
R&D performed abroad by U.S. companies	YES	YES	NO	NO	NO	NO	YES	NO
Regulatory R&D	NO	NO	NO	NO	NO	NO	YES	NO
Marketing/R&D relationship	NO	NO	NO	NO	NO	NO	YES	NO
1977 data available	Approx. 8/78	Approx. 1/78	5/77	1/77	1/77	12/76	11/76	Approx. 4/78

[1]Projections made only as to increases or decreases.
[2]Industry as a source of funds only; excludes Federal funds to industry.
[3]Presented on an individual company basis.
[4]All NSF/Census data categories are available by individual industry.
[5]Indicates additional detail available.
[6]Publishes NSF/Census data.

Survey Descriptions

[Throughout these descriptions, italicized portions under "Key data elements" are unique to that one particular survey.]

Title: Survey of Research and Development in Industry

Performer: NSF/Census

Description: Survey of large R&D performers and a sample of those companies with less than 1,000 employees. The sample for this survey is drawn every five years from Economic Census Enterprise Statistics file and the Census of Manufactures file.

Each year approximately 1,400 companies are mailed the survey form, providing their total performance for research and development was $200,000 or more in the year of resampling. Companies with programs below $200,000, which account for less than 1 percent of the industry total of total R&D spending, are mailed only in the year of the resample and have been imputed at that level until a new sample is drawn. In addition, each year the annual Department of Defense and National Aeronautics and Space Administration lists of R&D contractors are reviewed by Census to ensure that the large companies receiving awards are included in the NSF/Census survey.

Surveys are mailed in January following the year to be surveyed. Preliminary results are available in September. Full data are available 12 to 18 months after the survey year. The most recent data cover 1976 and are contained in *Science Resources Studies Highlights* entitled, "Industrial R&D Spending Reaches $26.6 Billion in 1976" (NSF 78-304).

Information on sampling ratios and standard error of estimates are included in final survey reports, together with definitions and descriptions of survey methodology and limitations.

Frequency: Annual

Key data elements: Includes R&D expenditures by source of funds, total domestic net sales, total domestic employment, R&D professional employment, R&D expenditures by character of work, type of R&D cost, *fields of basic research, applied research and development by product field, geographic area of research and development*, energy research and development by source of funds and type of energy source, pollution abatement research and development, and research and development performed outside the company. These statistics are provided for the total sample and on an industry-by-industry basis; e.g., the machinery industry, the instruments industry, etc.[2]

Assessment: Statistically valid survey of research and development. The data are aggregated by individual industry, allowing a greater level of detail than given in the other surveys discussed here. Although the sample is extensive, it is weakened by the inclusion of small R&D performers only during

TABLE 2.—STANDARD ERROR OF ESTIMATE (PERCENTAGE) OF FUNDS FOR R&D PERFORMANCE FOR ALL COMPANY SIZE GROUPS AND FOR COMPANIES WITH LESS THAN 1,000 EMPLOYEES, BY INDUSTRY: 1975[1]

Industry	Total	Companies with less than 1,000 employees
Total	(2)	(2)
Food and kindred products	1	35
Textiles and apparel	(2)	(2)
Lumber, wood products, and furniture	6	31
Paper and allied products	1	34
Chemicals and allied products	1	27
Industrial chemicals	(2)	11
Drugs and medicines	(2)	8
Other chemicals	8	47
Petroleum refining and extraction	(2)	3
Rubber products	2	38
Stone, clay, and glass products	3	38
Primary metals	1	17
Ferrous metals and products	(2)	17
Nonferrous metals and products	1	22
Fabricated metal products	7	29
Machinery	1	19
Office computing and accounting machines	(2)	37
Electrical equipment and communication	(2)	9
Radio and TV receiving equipment	(2)	(2)
Electronic components	1	17
Communication equipment and communication	(2)	20
Other electrical equipment	(2)	3
Motor vehicles and motor vehicles equipment	(2)	19
Other transportation equipment	8	31
Aircraft and missiles	(2)	24
Professional and scientific instruments	(2)	7
Scientific and mechanical measuring instruments	3	12
Optical, surgical, photographic, and other instruments	(2)	5
Other manufacturing industries	(2)	5
Nonmanufacturing industries	(2)	1

[1]The percentage (or relative) standard errors in this table may be converted to standard errors of estimate by multiplying the percentage shown by the associated estimate.

[2]Less than 0.5 percent.

[2]The aggregation of data by individual industry affords a greater level of detail for some items than other surveys.

the sample year (every fifth year). Companies are required by law to report total R&D expenditures, Federal R&D expenditures, and domestic net sales and employment, thus affording virtually complete coverage of the large R&D performers on these items. Standard error of estimate for the NSF/Census survey is less than 0.5 percent. The standard errors by individual industry and sampling ratios used in the NSF/Census survey are noted in tables 2 and 3.

TABLE 3.—SAMPLING RATIOS USED IN THE SELECTION OF MANUFACTURING AND NONMANUFACTURING COMPANIES INCLUDED IN THE SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT, BY INDUSTRY AND SIZE OF COMPANY, 1975

Industry	SIC code[1]	Companies with total employment of—				
		1-49	50-99	100-499	500-999	1,000 or more
Agriculture, forestry, and fisheries	07-09	[2]	0.010	0.020	0.200	1.000
Mining, except petroleum extraction	10-12, 14	[2]	.050	.050	.100	1.000
Contract construction	15-17	[2]	.050	.100	.500	1.000
Food and kindred products	20	.005	.005	.033	.500	1.000
Textiles and apparel	22,23	.005	.005	.025	1.000	1.000
Lumber, wood products, and furniture	24,25	.005	.005	.050	.500	1.000
Paper and allied products	26	.005	.005	.050	1.000	1.000
Industrial chemicals	281-82	.083	.083	1.000	1.000	1.000
Drugs and medicines	283	.250	.250	1.000	1.000	1.000
Other chemicals	284-89	.007	.007	.333	1.000	1.000
Petroleum refining and extraction	29,13	.050	.050	1.000	1.000	1.000
Rubber products	30	.007	.007	.143	1.000	1.000
Stone, clay and glass products	32	.005	.005	.143	1.000	1.000
Ferrous metals and products	331-32,3391,3399	.005	.005	.100	1.000	1.000
Nonferrous metals and products	333-36,3392	.005	.005	.500	1.000	1.000
Fabricated metal products	34	.005	.005	.100	1.000	1.000
Machinery	35	.005	.005	.100	1.000	1.000
Radio and TV receiving equipment	365	.067	.067	1.000	1.000	1.000
Communication equipment and electronic components	366-67,48	.025	.025	1.000	1.000	1.000
Other electrical equipment	361-64, 369	.050	.050	.250	1.000	1.000
Motor vehicles and other transportation equipment	371, 373-75, 379	.014	.014	.333	1.000	1.000
Aircraft and missiles	372,19	.083	.083	1.000	1.000	1.000
Scientific and mechanical measuring instruments	381-82	.143	.143	1.000	1.000	1.000
Optical, surgical, photographic, and other instruments	383-87	.050	.050	1.000	1.000	1.000
Transportation, except railroads[3]	41-47	[2]	.020	.020	.100	1.000
Public utilities and sanitary services	49	[2]	.100	.500	1.000	1.000
Wholesale trade	50-52	[2]	.010	.020	.200	1.000
Retail trade	53-59	[2]	.010	.020	.200	1.000
Finance, insurance and real estate	60-67	[2]	.010	.020	.200	1.000
Miscellaneous business services	739	.005	.200	.200	1.000	1.000
Medical and dental laboratories	807	[2]	1.000	1.000	1.000	1.000
Engineering and architectural services	891	.005	.500	1.000	1.000	1.000
Other manufacturing industries	21,27,31,39	.005	.005	.050	1.000	1.000
Other nonmanufacturing industries	.....	[2]	.010	.020	.200	1.000

[1]Executive Office of the President, Bureau of the Budget, *Standard Industrial Classification Manual, 1967.* (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office.)

[2]Companies in this employment-size group and industry group were not sampled.

[3]Companies primarily engaged in rail transportation were not included in the sample because, according to earlier surveys, such companies account annually for a relatively small amount of research and development in terms of the national total (less than 0.25 percent).

Title: *National Patterns of R&D Resources*

Performer: National Science Foundation

Description: Report which presents trend data on R&D funds and R&D manpower for each sector of the economy. The R&D funding data are estimated for the ensuing year;[3] R&D manpower data are provided for the year just past. Generally, a *Science Resources Studies Highlights* is published early in the year with a full report following in late spring. The 1977 data were published in the July 1977 *National Patterns of R&D Resources: Funds & Manpower in the United States, 1953-1977* (NSF 77-310).

Frequency: Annual

[3]The next report issued in this series will contain data for 1978 and 1979.

Key data elements: Total R&D spending, basic research, applied research, and development by source of funds and by performer. These data are provided in both current and constant dollars. Other data elements include R&D scientists and engineers by employing sector, and *doctorate scientists and engineers engaged in research and development.*

Comparability with NSF/Census Survey: Industry data published in this report that are not specifically labeled as estimates are the actual NSF/Census data. However, the *National Patterns* report also publishes projections of industrial R&D spending for the ensuing year. These estimates are compared in table 4 with the actual data as obtained in the NSF/Census survey.

TABLE 4.—NATIONAL PATTERNS AND NSF/CENSUS COMPARISON: 1972-76

[Dollars in millions]

Year	Actual NSF/Census[1]	*National Patterns* estimates	Percent difference
	Total industrial R&D funds		
1972	$19,383	[2]$19,200	-0.9
1973	20,921	[3]20,300	-3.0
1974	22,399	[4]21,525	-3.9
1975	23,540	[5]23,660	+1.4
	Company funds for R&D performance		
1972	$11,326	[2]$11,150	-1.6
1973	12,696	[3]12,200	-3.9
1974	14,059	[4]13,000	[6]-7.6
1975	14,776	[5]14,710	-.4

[1]All NSF/Census data published in this report are taken from *Research and Development in Industry, 1975* (NSF 77-324).
[2]*National Patterns of R&D Resources*: 1953-1972 (NSF 72-300).
[3]*National Patterns of R&D Resources*: 1953-1973 (NSF 73-305).
[4]*National Patterns of R&D Resources*: 1953-1974 (NSF 74-304).
[5]*National Patterns of R&D Resources*: 1953-1975 (NSF 75-307).
[6]R&D spending levels returned to a more normal growth pattern one year earlier than anticipated, following the 1970-73 recession.

Title: Business' Plans for New Plants and Equipment, R&D Section

Performer: McGraw-Hill Publications Company

Description: As part of a survey of approximately 1,800 companies on capital investment in industry, McGraw-Hill annually surveys 1,200 companies on R&D expenditures. Responses are received from approximately 450 companies. The survey requests total R&D expenditures in the preceding year, and projected 1-year and 3-year percentage increases. These percentages are applied to previously published NSF figures to yield R&D projections for the ensuing year, with the resultant data usually made available in May. McGraw-Hill published their 1977 data in a May 20, 1977 release entitled "Eleven Percent Spending Rise for Research and Development Planned by U.S. Business."

Frequency: Annual

Key data elements: Previous and current year's R&D expenditures, energy and pollution abatement research and development, product/process research and development, *new products as a percentage of future sales,* and projected 1-year and *3-year increases,* for each of these data elements. Data are provided for individual industries.

Comparability with NSF/Census Survey: McGraw-Hill data are collected without providing specific definitions and are published without information on survey methodology, weighting for nonresponse, and imputation rates. A survey followup is conducted, but the response rate is low. Since definitions and instructions are not provided, data may include capital expenditures for some companies and not for others; some companies may report research and development contracted out while others report intramural R&D activities only; market research expenditures may be included in some company responses. A comparison between McGraw-Hill and NSF/Census data for the 1972-73 period for the major R&D-performing industries shows that industry-wide totals are close to NSF/Census data but that large differences exist among individual industry totals (table 5). Table 6 compares the two sets of data for 1974, covering all industries.

TABLE 5.—MCGRAW-HILL AND NSF/CENSUS COMPARISON OF TOTAL R&D EXPENDITURES FOR SELECTED INDUSTRIES: 1972-73

[Dollars in millions]

Industry	NSF/Census	McGraw-Hill[1]	Percent difference
	1972		
Total	$19,383	$18,648	-3.8
Aircraft and missiles	4,992	4,914	-1.6
Electrical equipment and communication	4,916	4,498	-8.5
Machinery	1,960	1,923	-1.9
Chemicals	1,896	1,882	-.7
Motor vehicles	1,973	1,504	-23.8
	1973[2]		
Total	$20,921	$21,229	+ 1.5
Aircraft and missiles	5,084	4,778	- 6.0
Electrical equipment and communication	5,280	5,179	- 2.0
Machinery	2,191	2,285	+ 4.3
Chemicals	2,062	2,066	+ .2
Motor vehicles	2,437	2,302	- 5.5

[1]1972 data from press release "R&D Spending to Rise Modestly in 1972 and Beyond", May 5, 1972.
[2]1973 data from press release "18th Annual McGraw-Hill Survey Business' Plans for Research and Development Expenditures, 1973-1976," May 11, 1973.

TABLE 6.—MCGRAW-HILL AND NSF/CENSUS COMPARISON OF TOTAL R&D EXPENDITURES FOR ALL INDUSTRIES: 1974

[Dollars in millions]

Industry	NSF/Census	McGraw-Hill[1]	Percent difference
Total	$22,399	$22,403	+ .01
Food and kindred products	295	338	+14.6
Textiles and apparel	69	69	0
Lumber, wood products, and furniture	64	67	+ 4.7
Paper and allied products	237	251	+ 5.9
Chemicals and allied products	2,377	2,313	- 2.7
Petroleum refining and extraction	622	539	-13.3
Rubber products	290	340	+17.2
Stone, clay, and glass products	187	174	- 7.0
Ferrous metals	158	155	- 1.9
Nonferrous metals	153	158	+ 3.3
Fabricated metal products	293	295	+ .7
Machinery	2,484	2,483	- .04
Electrical equipment and communication	5,495	5,581	+ 1.6
Motor vehicles and other transportation equipment	2,425	2,412	- .5
Aircraft and missiles	5,319	4,811	- 9.6
Professional and scientific instruments	989	997	+ .8
Other manufacturing	174	175	+ .6
Nonmanufacturing	768	1,245	+62.1

[1]Data from press release, "R&D Spending to Rise, Spurred by Energy Problem", May 10, 1974.

Title: R&D Projections

Performer: *Industrial Research* magazine

Description: Projection of R&D performance in all economic sectors for the current calendar year. A 1978 projection was published on page 46 of the January 1978 issue. The article was entitled "R&D Funding Will Increase in Real Dollars This Year," written by Robert R. Jones. Informal discussions with R&D managers and the responses to the magazine's opinion poll provide the basis for projecting current year totals from published NSF/Census data for prior years. Data are published in the January issue.

Frequency: Annual

Key data elements: Projections of R&D funding by source, and an attitudinal survey on the increase of R&D funds, increase in product research and development, government R&D funding, and other current R&D issues.

Comparability with NSF/Census Survey: Base year statistics used in making the projection are actually obtained from the NSF/Census survey. *Industrial Research's* current editor and author of the 1978 projections, Robert R. Jones, indicated that the R&D dollar projections are his own estimates based on NSF figures and informal discussions with R&D managers. He indicated that the attitudinal survey generally represented opinions of middle level R&D professionals (table 7).

Title: Forecast 1978

Performer: *Research/Development* magazine

Description: Forecast of national R&D expenditures for entire economy, broken out by the four major sectors, for the ensuing year. Data are based primarily on NSF/Census survey results, Securities and Exchange Commission (form 10-K), company annual reports and a phone survey of approximately 45 companies. The phone survey is conducted in late November. Projections are published in the January issue. Current data available concern 1978. The article is located on page 22 of the January 1978, issue entitled "Forecast '78: $45.2 Billion for R&D," by C.J. Mosbacher.

Frequency: Annual

Key data elements: Projection of R&D funds by source for the current year.

Comparability with NSF/Census Survey: In the industry sector survey, an effort is made to collect only company-financed R&D expenditures, but, if this break is not available, total R&D funds are accepted. The informal survey sample used for the industry projection may not be statistically valid. Mr. Mosbacher cited his own article as an attempt to forecast future spending patterns in general. While his 1975 estimate for industry was nearly the same as the NSF/Census figure, 1973 and 1974 estimates were off by 6 percent and 9 percent, respectively, but 1975 was off by less than 1 percent (table 8).

TABLE 7.—*INDUSTRIAL RESEARCH* MAGAZINE AND NSF/CENSUS COMPARISON OF TOTAL R&D EXPENDITURES: 1971-74

[Dollars in millions]

Year	NSF/Census	*Industrial Research*[1]	Percent difference
1971	$18,311	$19,800	+ 8.1
1972	19,383	21,100	+ 8.9
1973	20,921	21,700	+ 3.7
1974	22,399	22,300	- .4

[1]Data from annual January projections of the year of data published.

TABLE 8.—*RESEARCH/DEVELOPMENT* AND NSF/CENSUS COMPARISON OF COMPANY R&D FUNDS: 1973-75

[Dollars in billions]

Year	NSF/Census	*Research Development*[1]	Percent difference
1973	$12.7	$12.0	-5.5
1974	14.1	12.9	-8.5
1975	14.8	14.7	- .7

[1]Data from annual January projections of the year of data presented.

Title: Probable Levels of R&D Expenditures: Forecast and Analysis

Performer: Battelle Memorial Institute

Description: Projection of total R&D funds by source and performer for ensuing year. Individual industry projections are made only in selected years. Data are published in December in the annual Battelle publication entitled, "Probable Levels of R&D Expenditures, Forecast and Analysis." The latest data available in this series were published in December 1977, and are projections for 1978.

Frequency: Annual, with projections by individual industries published on an irregular basis.

Key data elements: R&D data for industry as both source and performer, company research and development by individual industry, research and development contracted out by individual industry, *previous year's corporate profits.*

TABLE 9.—BATTELLE AND NSF/CENSUS COMPARISON OF COMPANY R&D FUNDS: 1973

[Dollars in millions]

Selected industries	NSF/Census	Battelle[1]	Percent difference
Total	$12,696	$12,200	- 3.9
Transportation equipment and missiles	3,123	2,852	- 8.7
Electrical equipment and communication	2,666	2,505	- 6.0
Machinery	1,857	1,579	-15.0
Chemicals	1,857	1,969	+ 5.5

[1]Data from *Probable Levels of R&D Expenditures, Forecast and Analysis*, Battelle Memorial Institute, December, 1972.

Comparability with NSF/Census Survey: The projections are made by employing a Battelle-generated model which incorporates data from the NSF data series, SEC reports, and other secondary sources. No survey is conducted. Battelle projections for industry total research and development usually compare well with NSF/Census data. At the individual industry level, however, substantial differences occur as shown in tables 9 and 10.

TABLE 10.—COMPARISON OF NSF/CENSUS ACTUAL DATA WITH BATTELLE ESTIMATES OF COMPANY R&D FUNDS: 1975

[Dollars in millions]

Industry	NSF/Census	Battelle[1]	Percent difference
Total	$14,776	$15,030	+ 1.7
Food and kindred products	323	345	+ 6.8
Chemicals and allied products	2,410	2,302	- 4.5
Petroleum refining and extraction	669	506	-24.4
Stone, clay, and glass products	184	178	- 3.3
Primary metals	356	290	-18.5
Fabricated metal products	298	322	+ 8.8
Machinery	2,286	2,196	- 4.0
Electrical equipment and communication	3,016	3,155	+ 4.6
Transportation equipment and missiles	3,203	3,240	+ 1.2
Professional and scientific instruments	854	943	+10.4
Nonmanufacturing	327	491	+50.2

[1]Data from *Probable Levels of R&D Expenditures, Forecast and Analysis*, Battelle Memorial Institute, December, 1974.

Title: IRI Trends Survey

Performer: Industrial Research Institute (IRI)

Description: Survey of IRI members (about 250 companies) on various aspects of research and development. IRI members include most large U.S. R&D performers with the exception of aerospace companies. The survey is typically mailed in August and requests projections for the coming year. Results are available in late fall for the current year along with projections for the next year. IRI data most currently available involved 1977 and were published in November 1976, in an IRI release entitled "Forecast of 1977 Trends in Research." No survey was conducted in 1977.

Frequency: Periodic

Key data elements: Survey concentrates on 3-year percent changes rather than absolute numbers. Items requested are R&D expenditures (sometimes by source); *capital spending for R&D operations*; direct salaries and wages attributable to research and development; research and development contracted out; international R&D spending; R&D professional and support employment, total company employment; *experienced R&D personnel newly hired; new graduates hired; total Ph.D.'s in research and development; female and minority R&D professionals; national R&D employment; research and development for proposed legislation; research and development for Occupational Safety and Health Administration requirements; environmental safety; etc., research and development for customer technical service;* energy research and development; *man-years devoted to top management attention to research and development; marketing/R&D interaction; new ventures licensing;* and total sales.

Comparability with NSF/Census Survey: The IRI survey asks for growth rates rather than absolute amounts. The exclusion of the aircraft and missiles industry from IRI totals prevents comparisons between IRI and NSF/Census industry-wide totals.

A major shortcoming of the IRI Trends Survey is the method in which the data are presented, making it largely impossible to compare results with the other available data sources. For example, the IRI states their 1975 survey results on employment of R&D professionals as: "About 60% of the respondents expect to increase their professional and technical R&D employment levels in 1975, while only 5% expect a decrease." This is difficult to compare with any of the other data sources described in this paper, which give an actual amount for each data item. The lack of weighting for large R&D performers in the data presentation and lack of definitions for the data items also inhibit direct data comparison. No followup for nonresponse is conducted. The survey is more or less informal among IRI members.

Title: Annual Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934 (Form 10-K)

Performer: U.S. Securities and Exchange Commission

Description: Consists of reports from all publicly held companies. Data must be filed within 90 days after the fiscal year to which the report applies. Thus, most 1976 data were available in the spring of 1977. R&D data are not aggregated. Individual company reports are available to the general public.

Frequency: Annual

Key data elements: *R&D expenditures by source of funds on an individual company basis; R&D scientists and engineers employed by source of funds on an individual company basis.*

Comparability to NSF/Census Survey: The R&D definition used by SEC is somewhat imprecise, affording firms the opportunity to include activities which are excluded from NSF/Census data. Since form 10-K is designed as an aid to investors, companies may report what they have provided to stockholders generally in their annual reports. NSF understands that no editing or follow-up for nonresponse is undertaken by SEC staff. Privately held companies are not included. These companies, however, do not represent a significant number of R&D performers or expenditures.

Regulated utilities and transportation companies, some of whom perform substantial amounts of research and development, are also generally not required to report. In addition, all companies that spend less than 1 percent of revenues on research and development are exempted from this requirement. This latter exclusion would include most companies in the food industry and, more significantly, petroleum firms which, as a whole, rank seventh among all industries in total R&D expenditures.

The Census Bureau has recently completed a study comparing *Business Week's* compilation of 1976 R&D data reported on Form 10-K, and R&D data reported by individual companies in response to the NSF/Census survey. Census confined the comparison to the top 200 R&D performing companies of the NSF/Census survey. The Census Bureau discovered that, while overall totals were similar, the two sets of data showed major differences on an individual industry basis.

Data from the top 200 companies were found to vary as follows:

66 companies were within 3 percent of the 10-K total;

32 companies differed by 3 percent to 10 percent;

36 companies differed by 10 percent to 25 percent;

38 companies differed by more than 25 percent;

28 companies were not included in the *Business Week* compilation.

The variations were primarily definitional, the Census Bureau discovered. Some companies, while following closely the instructions provided for the NSF/Census survey, included such items as routine product testing or engineering follow through on the 10-K, which are excluded from the NSF R&D definition.

Table 11 shows the results of the Census comparison on an aggregated basis.

TABLE 11.—NSF/CENSUS AND SEC FORM 10-K REPORTS COMPARISON FOR THE TOP 200 CENSUS R&D PERFORMERS BY INDUSTRY: 1976[1]

Industry	Percent difference[2]
Total	- 3.0
Food and kindred products	+ 9.0
Lumber, wood products, and furniture	+ 0.7
Paper and allied products	+25.2
Chemicals and allied products	+ 1.8
Industrial chemicals	+ 0.6
Drugs and medicines	+ 3.8
Other chemicals	0.0
Petroleum refining and extraction	- 6.8
Rubber products	+14.0
Stone, clay, and glass products	+10.0
Primary metals	- 7.8
Ferrous metals and products	0.0
Nonferrous metals and products	-13.6
Fabricated metal products	+ 6.2
Machinery	+ 6.2
Office, computing, and accounting machines	- 8.2
Electrical equipment and communication	-11.5
Electronic components	- 2.4
Communication equipment and communication	-13.7
Other electrical equipment	-10.6
Motor vehicles and motor vehicle equipment	- 2.9
Aircraft and missiles	- 7.2
Professional and scientific instruments	+10.5
Scientific and mechanical measuring instruments	- 5.7
Optical, surgical, photographic, and other instruments	+14.1
Other manufacturing industries	-32.7
Nonmanufacturing industries	- 6.8

[1] Although 1975 data were used in the remainder of this report, the Census Bureau utilized recently compiled 1976 survey data in making this comparison.

[2] SEC form 10-K data were taken from the June 27, 1977 issue of *Business Week*. NSF/Census data were newly compiled from the 1976 Survey of Research and Development in Industry.

Source: U.S. Bureau of the Census

U. S. GOVERNMENT PRINTING OFFICE : 1978 O - 265-797